Accelerator Systems Division Highlights for the Week Ending January 18, 2001

ASD/LBNL: Front End Systems

The 402.5 MHz coaxial circulator was repaired on Sunday, Jan. 13, under supervision of a technical expert from the German manufacturer AFT. Static pressure tests and RF transmission into a second water load, up to 200 kW power at very low duty factor, were successful. The circulator failed again, however, when 450 kW power was delivered into the RFQ. A second repair attempt was completed by Jan. 17, and the circulator was installed again and so far has delivered 400 kW power at low duty factor into the main water load without problem. In parallel, we are now actively pursuing the backup solution with a waveguide-type circulator and of other RF components from SNS-ORNL and LANL; a mechanical layout has been completed, and the shipment of needed components has been initiated by the two partner labs.

Final (LBNL) installation of the remaining MEBT electrical and mechanical infrastructure items is proceeding.

We received two more wire scanners with improved design details from BNL.

ASD/LANL: Warm Linac

The second 402.5-MHz klystron has operated satisfactorily at levels needed for the RFQ and the first two DTL tanks; however, multipacting is observed at power levels of about 1.5 MW RF. We met via videoconference with the Managing Director of Marconi Applied Technologies to develop a path forward that includes delivery of the second tube to maintain schedule, and the deployment of additional Marconi resources, including the original design team, retrofitting tube #1, testing tube #3, and implementing design changes on tubes #4 and beyond. (WBS 1.4.1.1)

The klystron cooling manifold for the JLab RF test stand is completely assembled and pressure tested. It includes flow meters, thermometers, and flow sensor interlocks (Figs. 1). Remaining tasks include completion of the unistrut support structure and the flow interlock summing electronics. Shipping is planned for late next week. Two LANL-LANSCE personnel are scheduled to go to JLAB the week of Feb. 4 to help with the final assembly and checkout of the system, including verification of the flow meters and interlocks. Another one will go the week of Feb. 11 to help with initial system commissioning. (WBS 1.4.1.1)

Fig. 1: Supply (top) and return (bottom) cooling manifolds for the JLab RF test stand klystron.

LANL and ASD personnel completed factory acceptance testing of the first production electrical substation for the high-voltage converter modulator (HVCM). Tests were fully satisfactory, often exceeding expectations. A strenuous series of high-current short circuit tests were performed. These tests require 7 short circuit events per test set. We had two sets, one with just the transformer, and one of the whole network that includes the trap networks and series chokes. The measure of success is that the transformer impedance does not change more than 2% of the nominal rated value. The test procedure starts by measuring the impedance of the transformer for a baseline. With

the secondary shorted with 2" copper rod, the short circuit testing is performed at 1/2 the applied voltage and the full applied voltage. The voltage is applied directly from a 2.25 GVA substation alternator! Changing the alternator field winding current controls the applied output voltage. For each phase of applied voltage (from the alternator), independent closing switches are used. Two switches are closed simultaneously, and a third is delayed. The timing of the delayed switch is such that it closes at peak voltage. Thus as the timing of the switches is changed, each phase is tested at peak voltage and fault current, whether at 1/2 the applied or the full voltage rating. This results in 6 tests. Each test lasts 25. The final test is all switches closing simultaneously, for one-second short circuit duration. Throughout the testing, additional impedance tests are made. This test procedure was performed twice, just with the transformer at the 1.5 MVA (nameplate) ratings, and with the transformer and trap networks at the (SNS) 1 MVA rating. The peak scatter in the data was 0.3%, which is in the noise, tolerance, and repeatability of the equipment. (WBS 1.4.2.2)

LANL staff visited DEI (Ft. Collins) for acceptance test on the MEBT chopper pulsers (Figs. 2-3). Results were satisfactory. Both the positive and negative output units were tested under operational conditions (60 Hz, 1-ms macropulses, with ~1-MHz chopping pattern at variable widths from 300 to 950 ns). Tests were performed at full output voltages of +/- 3000 V into a 50-ohm load, as required by the specifications, a comfortable margin above the nominal +/- 2350 V operational level. The pulse risetimes and falltimes were near the expected 10 ns, with minimal overshoot at ground potential. Shutdown and automatic recovery from an intentional shorted output was demonstrated as required, although a non-scheduled test of the output with a Tektronix high-impedance probe caused the five output FETs in the pulldown switch to fail. This gave us the opportunity to witness replacement of the FETs and return of the unit to service in less than four hours. The pulsers will be shipped directly to LBNL next week along with documentation. The DEI lead engineer on the project, Charles Coleman will arrange a trip to LBNL in February to assist with any operational issues. We also benefited greatly from discussions with the DEI chief technical officer, George Krausse (WBS 1.4.5.1).

Fig. 2 Shorting the MEBT chopper pulser output to demonstrate protection circuit.

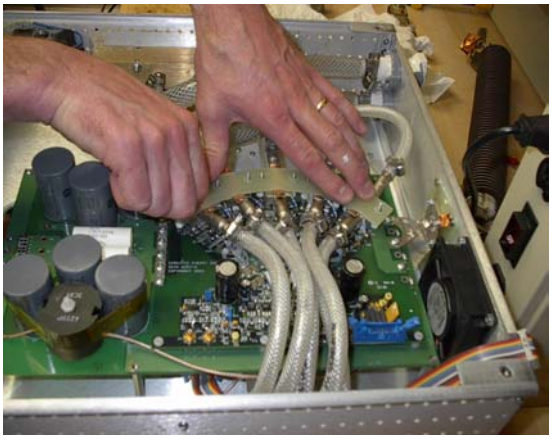


Fig. 3: Securing the chopper pulser cover over the water-cooled output FETs.

LANL approved PCR LI 01 090, submitted by ASD, for the HVCM spare parts.

Bids are back for the SRF linac quadruple coils. The technical evaluation is complete, a vendor has been selected, and the award is in progress. (WBS 1.4.9)

ASD/JLAB: Cold Linac

Recovery compressors have arrived at JLab.

Fabrication of bayonets and Y-valves is complete. The devices have been packaged and will be shipped to ORNL next week with a transportainer of other transfer line parts. Work can now begin on the production of U-tubes, but this is a relatively low-priority activity and will be used to maintain a level workload in the assembly area.

Cavity #3 was cryogenically tested, with marginal results. The cavity has been accepted for string assembly, but another processing step (BCP and high pressure rinse) will be carried out to achieve better performance.

Processed couplers at LANL have been packaged for return to JLab, where they will be used in the assembly of the prototype cryomodule.

The third pair of couplers is being prepared for high power processing at LANL in February. The run, originally scheduled to begin February 4, has been delayed by 1-2 weeks by the need to recommission the high voltage power supply after repair and modification.

The vacuum vessel for the prototype cryomodule has been received.

All major components are on hand for the RF test stand, with the exception of a water manifold to be provided by LANL, a circulator provide by ORNL and waveguide switches and shutters being procured by JLab. All racks have been placed in the test area and work is underway to install, plumb and rewire all internal subassemblies. (See Figure 2) Started high voltage checkout. Inconsistencies in safety logic need to be corrected.

Figure 1: Cavity 3 prior to insertion into dewar.

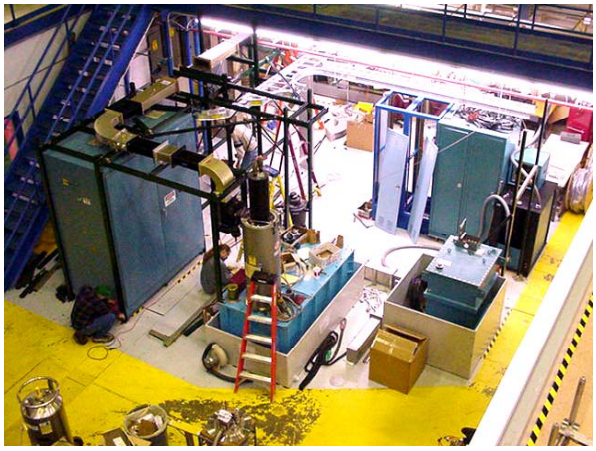


Figure 2: RF test stand.

ASD/BNL: Ring

PCRs are currently being prepared and/or processed for: Ring magnet spares, injection magnet spares, radiation hardened coils for six RTBT quad/corrector assemblies, spares for the low field and high field power supplies, and spares for the power supply interface / control modules.

The BNL Survey Group is providing extensive survey support related to the assembly and test station alignment of the 21CO26 corrector octupole magnet. Our goal is to determine root cause for changes in electro/mechanical offsets following tests after partial disassembly of this magnet, simulating magnet work for beam pipe installation.

Magnet measurement of Ring dipole magnet #9 was completed this week. We are still working to better understand the observed spread in the integral field transfer functions.

As mentioned earlier this month, an extraction kicker PFN has been successfully tested to 10kv in air. Efforts are now underway to install the PFN in its oil tank and test to rating at 60Hz. In addition, our engineering staff is reviewing the 1st article PFN tank fabrication in an effort to reduce production costs (an RFQ will be released later this year). Issues have been raised about the design rise time as noted in a recent e-mail from Jon Sandberg, which in part reads:

At this point changing this parameter (rise time) will probably require going to a different topology kicker. We will try to reduce the rise time on the prototype unit, but I believe we will not be able to make any significant reduction in this parameter. At this point I have asked Jian-Lin to put the kicker into the oil and see if it will pulse at full ratings before attacking the rise time problem."

Two SNS/BNL engineers returned from a west cost trip this week. While in California they conducted a pre-award vendor/equipment review at Alpha Magnetics (41CDM30 corrector magnets) and a first article magnet inspection at Stangenes, Inc. (26Q40 quadrupole). There were no major issues to report; all related efforts remain on track.

Tom Shea was at BNL this week. His focus was on the BCM electronics, laser wire testing (AGS), and the MEBT wire scanners.

Tom Owens was also at BNL this week to assist our RF Group with dynamic tuning of the first cavity.

Preparations are underway for the upcoming ASAC Review in mid February.

A contract was awarded this week to Varian Vacuum Products to provide the turbo molecular vacuum pump stations. A first article will be provided for acceptance testing prior to the start of the production run.

Our vendor, SDMS of France, plans to direct ship the six remaining vacuum chambers for the HEBT dipole magnets to SNS/OR this week. ETA is about four weeks.

Arrangements were made to send six more power supply interface modules (PSI) and one more power supply control module (PSC) to Danfysik for vendor acceptance testing of various low field power supplies. Testing is scheduled for late February.

Laser Wire Scanner - efforts are underway to filter and amplify signals to make beam profile measurements with very low beam currents (100 micro-amps). Diagnostics Group is still waiting to receive higher energy beam (200MeV) out of the AGS / Linac for planned measurements.

Controls:

Phase one of the RFQ emittance application is running and being tested and the prototype stepper motor chain for this application is assembled. Ernest Williams will go to Berkeley during the week of Jan. 22 for integration.

A preliminary Design review for the ODH System was held this week. The basic design was endorsed, but some assumptions underlying the hazard analysis for the linac tunnel were questioned, and will be reviewed. Archiving needs for radiation levels (measured by PPS Chipmunks) have been defined. The EPICS strip chart tool has been linked to the local PPS archiver so that radiation data can easily be retrieved and displayed for defined time windows. PLC Tag names for Phase 0 PPS have been generated per the naming convention, and new device and signal names have been submitted for approval.

Target Utility system controls drawings pertinent to the Target building General Contractor were stamped and signed CFC this week. These drawings will be included with the General Contractor bid package to be released soon. The remaining Target Utility controls drawings will be signed CFC on March 1.

The cabling web page was expanded greatly to include design criteria and electrical commodities contract catalog information needed by cable designers.
Streamlined design criteria with tray rating, voltage rating, radiation resistance, color-coding and other requirements needed by designers was drafted. Functional System Documents (FSDs) for power monitoring and Front End CF control systems were issued for comment. These will be used as test examples for the technical database. An analysis of radiation doses in various areas of the plant was completed, and sensor locations moved where necessary. No CF controls sensor or cabling are in areas requiring radiation resistance.

SNS and JLab personnel reviewed the logic description provided by the vendor for control of the main 4.5 K Cold Box in detail. SNS personnel are to implement this logic in one of the cryogenic control system PLCs. A list of questions and comments was prepared for transmittal to the vendor. The first two silicon diode cryogenic temperature sensor input modules were received from the vendor, and have been shipped to JLab for testing and verification.

Two Power Supply Controller (PSC) units were shipped from BNL to ORNL this week. Other PSC and PSI units will be sent after the design review next week. The test lab at BNL is being set up for a demonstration of the power supply interface at the power supply design review. Test hardware is being set up in the timing system lab to demonstrate the hardware and software at the timing system software review also scheduled for next week.

A first Tape Back up was run successfully on the new EPICS servers.

A Generic PCI record for EPICS has been written and is under test. This was designed for the MPS system, but will be of general applicability and so will be distributed to the EPICS community.

At LANL, software for reading waveforms and testing performance of the new Direct Memory Access (DMA) interface to the High Power Protect Module (HPM) was prepared. Some mismatches in the LLRF HPM register displays were fixed. Preparation continued for the transmitter acceptance test scheduled at Titan/Maxwell next week. This included adapting the most recent signal list and screens.

At Berkeley, progress was made on the interface chassis for the MEBT vacuum and cooling, and PLC ladder logic was completed for the MEBT vacuum system. Interface equipment (FlexIO) for the MEBT cooling system was received.

PLC programming guidelines were issued for signature this week.

ASD/ORNL: Integration and Installation Support

Accelerator Physics

A draft report on halo scraping options for the Front End and DTL was submitted. The preferred options to be pursued are scraping in the MEBT and possibly modifying the MEBT optics at a later date. Scraping at the LEBT is possible, but less effective. Finally, scarping in the DTL is least effective and not recommended.

There are two new members of the accelerator physics group: Tom Pelaia who will work in the applications programming team, and Leonid Kravchuk who will work in the linac area.

Detailed field maps are being produced for the LEBT using MAFIA. These maps will be used to track partially chopped beams, which will then be followed through the RFQ, MEBT (with chopping also) and the rest of the machine.

Sarah Cousineau attended the USPAS accelerator physics school.

Two bid packages were checked and approved (post facto); 24D68 injection chicane dipole and 41CDM30 ring correctors.

Approximately 15% of the stripped electrons are found to scatter back toward the injection foil from the copper electron catcher. These backscattered electrons are a concern because they may: 1) be directed back to the stripping foil adding to the foil heating, 2) strike the upper portion of the uncooled stainless steel vacuum chamber causing heating difficulties, and 3) produce low-energy secondary electrons which interact with the beam fields leading to stability problems. Work is underway at BNL to track these backscattered electrons to understand where they land.

Two working points have been studied for the new collimator location layout in the north ring tunnel. The collimation results for the 6.40, 6.30 working point are quite similar to the 6.23, 6.20 working point. The fraction of beam particles lost on the quadrupoles in the collimation straight section is substantially reduced at the new collimator location.

Preparation for the ASAC commissioning presentation continues. The commissioning team has been meeting weekly with BNL for discussion of various commissioning topics.

Operations

Ion Source Group

Paul Gibson had several discussions with TTI as they undergo a reduction in force. TTI assured him the completion and delivery of the LEBT vacuum- another LEBT components without any significant delay.

The 13.6 MHz RF Generator was received from Comdel.

We received the high voltage resistors from Victoreen. The shipment included pre-load resistors for the 60 kV lens supplies to stabilize the lens voltage when intercepting negative ions.

Robert Welton completed posting his tech notes in the ASD web based "tech note depository."

Three additional "radiation alert" monitors have been received. These $279 hand-held monitors provide a reliable and inexpensive verification that our equipment does not pose any unexpected radiation hazard.

RF Group

The digital feedback hardware - the heart of MEBT LLRF system, is being tested at LBNL. The initial test conducted during last week and early this week was successful. It proved the basic functions of the circuit hardware and the FPGA code design, which include ADC-DAC data throughout, digital I/Q data demodulation and modulation, as well as the detection and synchronization of the clock signals. The first prototype of the RF front-end chassis was also tested with the digital hardware. LANL clock distribution module was used in this test.

Mechanical Group

Magnet Measurement Group

Cryogenics Group

Electrical Systems Group

Tom Owens traveled to BNL and observed tests of the dynamic tuning system for the ring RF system. Obtained the following notable information relevant to project performance and schedule:

Test-stand rf voltage in excess of 11 kV was obtained across the ring gap as the buncher cavity resonant frequency was tuned over the range 1.05 MHz to 1.22 MHz in a 1 millisecond time interval at a 60 Hz repetition rate. The gap voltage obtained in these tests exceeds the formal specification of 10 kV. The 170 kHz tuning range obtained in the tests will compensate beam reactance for beam current levels equivalent to approximately 2E14 protons per pulse, easily satisfying present requirements.

The above performance for the dynamic tuning system was obtained by driving the ferrite bias with a 180 Hz sine wave having amplitude of 500 Amps p-p and an offset of approximately 450 Amps. RF drive was applied over a fairly linear portion of the sine wave in order to approximate a linear bias-current ramp. A fixed frequency of 180 Hz was found, by empirical means, to minimize mechanical vibrations resulting from Lorentz forces induced by the time-varying bias current within the buncher cavity. The bias waveform also provided adequate compensation of hysteresis effects in the cavity ferrites.

BNL decided not to order additional power supplies from the Industrial Test Equipment Company (ITEC) for the production versions of the dynamic tuning system. The decision was made after a number of problems were uncovered with the ITEC supplies during operation. Originally, it was thought that the dynamic-tuning supplies required uncommonly high bandwidths, approaching 5kHz, in order to provide a fast ramp for dynamic tuning. With a 180 Hz sine wave, power supply bandwidths need be only a few hundred Hertz, a requirement much easier to satisfy. The BNL power-supply group is now recommending a high-quality Dan Physik power supply for dynamic tuning. BNL is expecting the cost to be roughly $50,000 per supply. This price matches that estimated by Copley

Controls for an acceptable high current, high frequency supply that we located for BNL. The Copley supply exceeds the frequency response now required in light of the latest operating mode. A decision on which supply to purchase is pending.

BNL expects to receive production cavities sometime this May. They will test each cavity at BNL as they are received.

BNL has finalized the design of the cathode heater supplies after completing prototype evaluation on the test stand. They have begun fabrication of the first production-version cathode heater supply. Each supply is feed-back regulated and provides 500 A of ac current at 24 Volts to the TH558 tetrode filament. Each supply occupies an entire equipment rack.

A small amount of Lorentz-force-induced vibration remains in the cavity. Will this residual vibration have long-term effects, such as fracturing the ferrite disks from extended exposure to mechanical cycling forces. No concerns over the vibration were expressed by BNL.

RF power-loss measurements indicated that the unloaded shunt impedance of the cavity was eight times higher than BNL had previously published. The higher shunt impedance presumably arises from much-lower-than-expected ferrite losses. The higher shunt impedance will lead to much higher beam-induced voltages at the gap than previously estimated. BNL was not concerned, pointing out that spark gap devices protect the ring gap from over-voltages. Besides greater potential for over voltages at the gap, the gap-voltage regulation system needs to be reviewed, since higher beam-induced gap voltages require higher compensating voltages and greater care in controlling gap voltage.

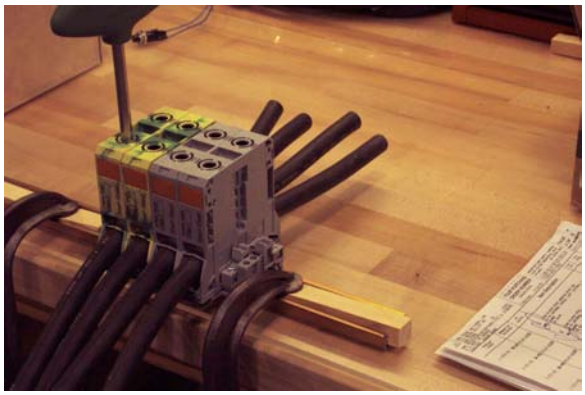
Finished the final assembly and check out of the corrector power supply interlock simulation chassis in RATS. This chassis was necessary to build in order to speed up the testing process and to reduce errors during testing.

The PPS chassis is under going some changes in RATS. It was brought over for a look-see and had some problems. One was the 208 vac, 3 phase terminal block on the back. This feed-thru is not the correct one to use, not safe. We have one on the way that should be the correct one. A ground stud is needed on the back panel to tie to the racks copper ground buss. The ac ground was not grounded to the chassis. There was also a question on the operation of the internal 24-volt dc supply and the PPS Permit lights. We need to get a write up from Paul Wright on how he thinks the chassis functions so we can verify.

Reviewed options for DTL steerers with ORNL and LANL physics group and LANL engineers. As initial bids came in well over ETC, we are trying to satisfy physics requirements without committing more money. The original physics requirements were somewhat conservative; if we relax these requirements we can come up with an on-budget solution. We should have all the information we need to make a decision by next week.

Mock-up of LINEAC racks assembly on a C channel base has been done in RATS to show how the rack layout.

High current self-locking terminals have been tested and evaluated.



Survey and Alignment Group

Epoch II of the Linac floor settlement observations has been completed. The observations at this time are limited to the first 195 feet of the linac tunnel. Although the detailed results will be made known sometime next week, the initial analysis indicates minimal changes between 01 November 2001, and 10 January 2002.

During the week of January 14, two of our site permanent monuments sustained damage when a site construction worker disassembled mechanical components. This was not intentional act destruction but the actions of an untrained site worker that should not have been using the monuments without proper instruction. We are presently working on damage control and the repair / re-measurement of these two monuments. Hopefully we will have the damaged repaired by the end of the month.

Beam Diagnostics Group BNL SNS Beam Diagnostics Weekly Report:

1.5.7.1 BPM: Six additional 21cm Ring BPM PUEs have been delivered to the Vacuum Group for welding to the beam pipe, vacuum firing, and nitrating. Strip-line modifications to permit vacuum firing are continuing. Completed machining mounting flanges for the 21cm Ring, 21cm HEBT and 12cm HEBT BPMs. Finished machining the outer shells for the 21cm HEBT BPMs.

1.5.7.3 BLM: An abstract was submitted to EPAC. Drawings were completed for the prototype 'fast BLM' and submitted to the shops, which have been working fast. All machined parts except the electrode are complete. Next generation AFE prototype artwork efforts continue

.

1.5.7.4 BCM: An abstract was submitted to EPAC. Our second PCI interface card from LANL has developed a problem internal to the FPGA. This will leave us with no development tool after we ship our electronics package. We therefore kept the working unit at BNL for Tom Shea's visit, which was Monday and Tuesday of this week. The second (backup) BCM AFE board is now functional and working better than the original. This is the board we will ship to LBNL. At a Monday video conference with software people, the process variables were reviewed, and changed to include a total particle calculation, and a comfort display representation of the average (filtered) beam current waveform. Software was revised to provide an integration of the current to present a total particle count, and software was developed to provide a comfort display of a filtered version of the beam current. This has been restricted to 256 points, and will display any time window, user selected by start time and display time input variables. It automatically adjusts the filter bandwidth to present a good representation of the current shape. A document is in preparation describing the equipment being shipped to LBNL, along with software operating instructions. The second revision of the AFE board preliminary layout has been received and is undergoing review.

1.5.7.5 Tune: An abstract was submitted to EPAC. Various data on tune measurement at RHIC were forwarded to ORNL. Work continues to incorporate features of those measurements into the Ring tune measurement system.
1.5.7.6a Carbon Wire Scanner: All wire scanners have been shipped to LBNL. Berkeley reports having received the first lot of three in good condition.

1.5.7.6b Laser Wire Scanner: An abstract was submitted to EPAC. BPM signals have been observed at the 200MeV POP experiment with the low intensity polarized beam. Sum and difference hybrids have been timed in. A tunnel access was completed to add low-noise preamps in the BPM and carbon wire signal paths to improve S/N. We expect to be able to measure profiles in the next day or two. Measurement at this low beam intensity will be equivalent to measuring well into the tails at SNS. The laser placed into the Linac BLIP tunnel for radiation tests has failed. The gamma-sensitive film did not register since the dose rate was below its useable range. Neutron dosimetry was done by exposing copper blocks. This test requires the blocks be out of vacuum for several weeks before measurements are made. We are setting up a trip for an expert from the laser company to visit BNL to determine the reason for failure. We are interested to see if the radiation-sensitive components can be moved to the power supply to make the head more rad hard.

LANL SNS Beam Diagnostics Weekly Report:

BPM pickups: Modifications to the mapper to incorporate the fiducial modifications on the drift tubes is almost complete. We plan to map the two DTL tank 3 BPMs in early February. The CCL and SCL prototype pickups are expected by the end of January.

BPM electronics: The noise problem mentioned in last week's progress report, due to calibration signal bleed through, is expected to degrade the position resolution of the MEBT 1 BPMs to 0.044 mm, and the MEBT 2 BPMs to 0.12 mm. The requirements call for a resolution of 0.1% of aperture radius, or 0.015 mm for MEBT 1 and 0.02 mm for MEBT 2. There is work around to regain the resolution, but of course work is underway to solve the problem at the PC board level.

WS actuators: SCL ball lead screw repairs continue. Fabrication continues on a prototype fork with collets to mount the carbon wires. Fabrication continues on a spare bellows assembly for the SCL actuator.

WS electronics: All six signal processor chassis have been checked. The prototype BNL actuator was received from LBL. It is now connected and running well. We also received a cable assembly from BNL. The next step will be to connect the signal processor and measure the noise during a simulated profile scan.

CMs: We received 7 DTL CM transformers from Bergoz.

D-plate: Final design work continues.

ED/FC: Design work is essentially complete. Thermal model calculations are in progress to determine the maximum beam power for each ED/FC unit. We are fabricating prototype water-cooling lines that run inside the actuator stem.

Software: Work continues on the software needed to serve data to the network.

Misc: We have tentatively scheduled the final design reviews for the BPM, CM, WS, ED/FC, and D-plate for March 12-14.

ORNL SNS Beam Diagnostics Weekly Report:

The group continues works on the installation planning at RATS and the SNS site. We are breaking the tasks to sub-activity level to assign “RATS” or “SITE” installation designations to them. These tasks will be integrated with the group’s EDIA activities to form a complete plan. Controls and Diagnostic group continues working on the Emittance Scanner data acquisition and analysis of the Front end. At the installation meeting, Dave gave a demonstration of an automated test system that is integrated with the Oracle database. Some example code for the BCM was developed and successfully benchmarked at 6 Hz. At BNL, Tom met with John Smith and Sheng Peng to clarify their role in EPICS integration. After next week’s controls reviews, Sheng will write a driver and device support for our generic shared memory architecture. Sheng has already requested the DLLs from Matt Stettler.